

CLAIMS

- 1 1. A method for efficiently searching a hash table containing a plurality of ranges,
2 the method comprising:
3 performing one or more preliminary range checks on at least one target value,
4 each preliminary range check generating an output value having a value dependent on
5 whether the target value is included in a predefined range of values associated with the
6 preliminary range check;
7 combining signature information with the output values generated by the prelimi-
8 nary range checks to generate a modified signature;
9 applying a predetermined function to the modified signature to derive an index
10 that references a hash-table entry in the hash table;
11 locating a searchable data structure associated with the hash-table entry refer-
12 enced by the index, the searchable data structure comprising one or more search nodes, at
13 least one of the search nodes configured to store one or more target-value ranges associ-
14 ated with the target value; and
15 searching the search nodes in the searchable data structure until a matching search
16 node is found whose stored target-value ranges associated with the target value include
17 the target value.
- 1 2. The method of claim 1, wherein the searchable data structure is a linked list and
2 the search nodes in the searchable data structure are linked-list entries.
- 1 3. The method of claim 1, wherein the output values generated by the preliminary
2 range checks are concatenated with the signature information to generate the modified
3 signature.
- 1 4. The method of claim 1, wherein the step of searching the search nodes in the
2 searchable data structure further comprises:

3 searching the search nodes until a matching search node is found that not only
4 stores target-value ranges including their associated target values, but also stores the sig-
5 nature information.

1 5. The method of claim 4, wherein the signature information and the target value are
2 obtained from predetermined fields in a packet's network headers or from other packet-
3 related information.

1 6. The method of claim 5, further comprising:
2 extracting data-flow information from the matching search node, the data-flow
3 information being used to route the packet.

1 7. The method of claim 1, wherein the step of applying a predetermined function to
2 the modified signature generates one or more output bits, and a predetermined set of the
3 output bits are masked to derive the index.

1 8. An intermediate network node configured to perform flow-based processing, the
2 intermediate network node comprising:
3 a network interface for receiving a data packet;
4 a memory adapted to store a hash table organized as a plurality of indexed hash-
5 table entries, each hash-table entry associated with a corresponding linked list and each
6 linked list containing one or more linked-list entries; and
7 a system controller configured to efficiently search the hash table, the system
8 controller:

9 obtaining signature information and at least one target value from a
10 set of predetermined fields in the received packet's network headers;
11 performing one or more preliminary range checks on at least one
12 of the target values, each preliminary range check generating an output
13 value having a value dependent on whether the target value is included in
14 a predefined range of values associated with the preliminary range check;

15 combining the signature information with the output values gener-
16 ated by the preliminary range checks to generate a modified signature;
17 applying a predetermined function to the modified signature to de-
18 rive an index that references a hash-table entry in the hash table;
19 locating a linked list associated with the hash-table entry refer-
20 enced by the index, the linked list comprising one or more linked-list en-
21 tries, each entry configured to store at least one target-value range associ-
22 ated with the target value; and
23 searching linked-list entries in the linked list until a matching
24 linked-list entry is found whose stored target-value ranges associated with
25 the target value include the target value.

1 9. The intermediate network node of claim 8, further comprising a processor,
2 wherein the memory is further adapted to store instructions for execution by the
3 processor, at least a portion of the instructions defining a router operating system con-
4 figured to route the received packet based on a data flow associated with the received
5 packet.

1 10. The intermediate network node of claim 9, wherein the system controller identi-
2 fies data-flow information stored in the matching linked-list entry and transfers the data-
3 flow information to the router operating system which routes the received packet in ac-
4 cordance with the data-flow information.

1 11. The intermediate network node of claim 8, wherein the system controller searches
2 the linked-list entries until a matching linked-list entry is found that not only stores tar-
3 get-value ranges including their associated target values, but also stores the signature in-
4 formation.

1 12. The intermediate network node of claim 11, further comprising a processor,

2 wherein the memory is further adapted to store instructions for execution by the
3 processor, at least a portion of the instructions defining a router operating system con-
4 figured to route the received packet based on a data flow associated with the received
5 packet.

1 13. The intermediate network node of claim 12, wherein the system controller identi-
2 fies data-flow information stored in the matching linked-list entry and transfers the data-
3 flow information to the router operating system which routes the received packet in ac-
4 cordance with the data-flow information.

1 14. An apparatus for efficiently searching a hash table containing a plurality of
2 ranges, the method comprising:
3 means for performing one or more preliminary range checks on at least one target
4 value, each preliminary range check generating an output value having a value dependent
5 on whether the target value is included in a predefined range of values associated with the
6 preliminary range check;
7 means for combining signature information with the output values generated by
8 the preliminary range checks to generate a modified signature;
9 means for applying a predetermined function to the modified signature to derive
10 an index that references a hash-table entry in the hash table;
11 means for locating a searchable data structure associated with the hash-table entry
12 referenced by the index, the searchable data structure comprising one or more search
13 nodes, at least one of the search nodes configured to store one or more target-value
14 ranges associated with the target value; and
15 means for searching the search nodes in the searchable data structure until a
16 matching search node is found whose stored target-value ranges associated with the target
17 value include the target value.

1 15. The apparatus of claim 14, wherein the searchable data structure is a linked list
2 and the search nodes in the searchable data structure are linked-list entries.

1 16. The apparatus of claim 14, wherein the output values generated by the prelimi-
2 nary range checks are concatenated with the signature information to generate the modi-
3 fied signature.

1 17. The apparatus of claim 14, further comprising:
2 means for searching the search nodes in the searchable data structure until a
3 matching search node is found that stores target-value ranges including their associated
4 target values and also stores the signature information.

1 18. The apparatus of claim 17, wherein the signature information and the target val-
2 ues are obtained from predetermined fields in a packet's network headers or from other
3 packet-related information.

1 19. The apparatus of claim 18, further comprising:
2 means for extracting data-flow information from the matching search node, the
3 data-flow information being used to route the packet.

1 20. The apparatus of claim 14, wherein the means for applying a predetermined func-
2 tion to the modified signature generates one or more output bits and a predetermined set
3 of the output bits are masked to derive the index.

1 21. A computer-readable media including instructions for execution by a processor,
2 the instructions for a method of efficiently searching a hash table comprising a plurality
3 of ranges, the method comprising:

4 performing one or more preliminary range checks on at least one target value,
5 each preliminary range check generating an output value having a value dependent on
6 whether the target value is included in a predefined range of values associated with the
7 preliminary range check;

8 combining signature information with the output values generated by the prelimi-
9 nary range checks to generate a modified signature;

10 applying a predetermined function to the modified signature to derive an index
11 that references a hash-table entry in the hash table;
12 locating a searchable data structure associated with the hash-table entry refer-
13 enced by the index, the searchable data structure comprising one or more search nodes, at
14 least one of the search nodes configured to store one or more target-value ranges associ-
15 ated with the target value; and
16 searching the search nodes in the searchable data structure until a matching search
17 node is found whose stored target-value ranges associated with the target value include
18 the target value.